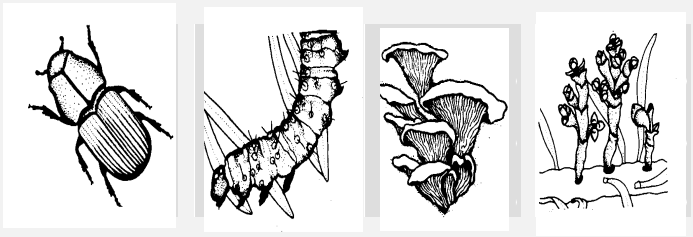
Forest Health Protection



Report 99-6 **APRIL 1999**

DOUGLAS-FIR BEETLE HAZARD RATING SYSTEM USING THE ORACLE DATABASE AND THE FOREST SERVICE IBM PLATFORM

Carol Randall[1], Greg Tensmeyer[2]

INTRODUCTION

The best strategy for minimizing losses to the Douglas-fir beetle (*Dendroctonus pseudotsugae*) is prevention (Furniss 1959, Furniss and Orr 1978, Lejeune et al. 1961, Patterson 1992). Susceptible stands of Douglas-fir can be identified and managed to reduce their susceptibility prior to some type of stand disturbance which may trigger an outbreak. This approach is the best way to prevent beetle caused mortality.

There is no standard Douglas-fir beetle hazard rating specifically for the inland northwest, though a hazard rating system has been developed in central Idaho (Weatherby and Thier 1993, Steele et al. 1996), and the Canadians have a risk rating system on their web page (www.pfc.cfs.nrcan.gc.ca/ landscape/ beetle/dfir/dfb-rr.html). In order to assess the potential scope of current Douglas-fir beetle populations in the Northern Region, we developed a hazard rating system which utilizes stand summary or stand information to stratify stands into high, moderate, low, and extremely low hazard strata. This hazard rating utilized the Weatherby/Thier system and incorporated work by Furniss et al. (1981). The system follows a step-wise progression to determine the appropriate hazard. The Region 1 National Forests have placed stand summary information (the Timber Stand Management Record System or TSMRS) and stand exam data (R1-Edit) into Oracle data bases on the IBM system. Using Oracle's PL/SQL procedural language, we created a query which sequentially sorts stands into different hazard classifications.

HAZARD RATING

Hazard is a measure of a stand's ability to support a population of Douglas-fir beetles. It is defined by 2 factors: the quality and the quantity of breeding material which may become available for beetles (Cornelius 1955, Furniss 1965, Furniss et al. 1979, Wright et al. 1984). Hazard for Douglas-fir beetle considers stand characteristics which, if the stand experiences disturbance, such as windthrow, defoliation, or fire scorch, may provide beetles with abundant breeding material.

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[1]Region 1 Forest Health Protection Entomologist

[2]Idaho Panhandle National Forest Computer Specialist

United States Department of Agriculture | Forest Service | Northern Region | 200 East Broadway P. O. Box 7669 Missoula, MT 59807

The quality of Douglas-fir beetle breeding material is best characterized by the size and age of the Douglas-fir trees present (Rudinsky 1966). Generally speaking more beetles are produced in larger, older trees.

The quantity of the food source refers to the species composition and density of the forest. A pure, well- to heavily stocked Douglas-fir stand is more likely to support large Douglas-fir beetle populations than mixed-species or poorly stocked stands.

HAZARD RATING CRITERIA

This hazard rating system follows a step-wise progression to determine hazard. A stand's "falls out" at the first statement which describes its condition. Logic of this step-wise progression follows:

Douglas-Fir Beetle Hazard Rating Logic

1. If % BA DF = 0	Then Hazard = 0-Extremely Low
2. If % BA DF <15%	Then Hazard = 1-Very Low
3. If Stand BA <80 sq. ft.	Then Hazard = 2-Very Low
4. If Average DF >9" d.b.h. <10"	Then Hazard = 3-Low
5. If Average Stand Age <80 years	Then Hazard = 4-Low
6. If % BA DF 15-30%	Then Hazard = 5-Low/Moderate
7. If Stand BA = 80-120 sq. ft.	Then Hazard = 6-Moderate
8. If Average DF Diameter 10-14"	Then Hazard = 7-Moderate
9. If Average Stand Age = 80-120	Then Hazard = 8-Moderate
10. If % BA DF 30-50%	Then Hazard = 9-High
11. If Stand BA = 120-250	Then Hazard = 10-High
All Else	Hazard = 11-Very High

TSMRS VS. R1-EDIT DATA

The hazard rating system uses either TSMRS or R1-Edit data. TSMRS data is stand summary data and is not as precise as R1-Edit data. TSMRS data summarizes stand information by diameter class and plurality species. Because data is summarized, if Douglas-fir is not the plurality (majority) species for a given diameter class, its presence may not be recognized and the assigned hazard my be artificially low. If Douglas-fir is the plurality species, but is present in a mixed conifer stand where other species are present in appreciable levels, assigned hazard rating may be artificially high. Though hazard ratings for individual stands may be artificially high or low, the benefit of using TSMRS data is coverage. TSMRS data may be gathered through aerial photo interpretation and quick surveys which do not meet the requirements of R1-Edit data but allow more stands to be hazard rated. Across a landscape, TSMRS data will provide a more complete picture of Douglas-fir beetle hazard.

R1-Edit data is tree-level, stand exam data. Hazard ratings assigned using R1-Edit data are more accurate for a given stand. Across a landscape level, however, R1-Edit information

is not available for as many stands. Maps generated from R1-Edit hazard ratings tend to be less complete than those generated from TSMRS data making landscape assessment more difficult.

For planning purposes, two Douglas-fir beetle hazard rating maps, 1 utilizing TSMRS data and 1 utilizing R1-Edit may be useful. If R1-Edit information is available for most stands in a planning area, then TSMRS hazard rating may be unnecessary. In many instances, however, R1-Edit data is not available for a large portion of the planning area and having TSMRS hazard ratings to help fill in the gaps is useful.

INTERPRETING HAZARD

High-hazard stands are those in which large amounts of Douglas-fir mortality would be expected once a disturbance occurs. Moderate- and low-hazard stands may experience less beetle-caused mortality; but large, old Douglas-fir might still be killed.

High beetle populations are generated in susceptible trees and in material generated by disturbances such as windthrow and fire. Once beetle populations have reached high levels, more relatively healthy trees are attacked.

When high-hazard stands are surrounded by low-hazard stands, beetle populations may not be as destructive. Low-hazard stands may have Douglas-fir, but either not of high enough quality or in large enough quantity to allow beetle populations to remain at extremely destructive levels. Douglas-fir beetle may still cause significant mortality in the Douglas-fir components of low-hazard stands in a landscape, but net losses will be lower than in a landscape where high-hazard stands are clustered.

HAZARD RATING CONSIDERATIONS

Analysis Assumptions

This analysis assumes that the stands contained in either the TSMRS and/or R1-Edit databases are a representative sample of the range of conditions in the landscape. A number of stands may not be in TSMRS or R1-Edit, or have insufficient data which would result in those stands not being assigned a hazard rating value. District personnel are strongly encouraged to carefully look at the stands rated and judge if they are a representative sample of landscape conditions.

Hazard rating assumes stands are homogeneous. If there is variability within the stand in any of the parameters used to determine hazard, the system is unable to detect it and cannot adjust the hazard accordingly.

This system provides the user with printouts of stand characteristics. No attempts have been made to "grow" stands from the date of the exam to the current date. It is important to consider the age of the data when interpreting hazard. Many characteristics of the stand used in hazard determination may have changed since time of the exam, and actual hazard may be greater than it appears. As always, it is prudent to ground check results.

Appropriate Use of Hazard Map

Hazard maps produced from data from the query are valuable resources for managers and planners at the geographic area assessment level. Such maps help managers identify areas which may experience significant Douglas-fir beetle mortality and contribute to an outbreak of Douglas-fir beetle after disturbance.

Hazard rating does not predict when or even if the Douglas-fir beetle will be active in a certain stand. We know stand disturbances occur with some regularity over a landscape,

and that Douglas-fir beetle populations can increase to outbreak proportions when large amounts of weakened or windthrown Douglas-fir occur.

Hazard rating cannot predict stand losses from Douglas-fir beetles. Hazard ratings identify stands with conditions that would support a Douglas-fir beetle outbreak, and stands that could suffer considerable mortality once an outbreak occurs. It does not address beetle populations. In order to address loss, it is necessary to collect additional data about beetle populations at the stand level.

PROJECT PLANNING

A hazard map is the easiest way for managers to quickly identify areas with a high quantity of trees susceptible to Douglas-fir beetle, thus the areas most likely to experience significant Douglas-fir beetle-caused mortality during an outbreak.

In areas of concern, managers need to assess the availability of appropriate beetle-breeding material, recently created larger diameter downed trees or the abundance of trees stressed by root disease, defoliation, snow breakage, fire damage, defoliation, etc.. Beetle pressure is a dynamic variable and may change quite suddenly due to factors such as adverse or favorable weather conditions or immigration of beetles from another location.

At most project levels the assumption that the stands are homogeneous is no longer appropriate. Additional information from a variety of sources, including recent walk through, aerial photography, and insect aerial detection surveys should be gathered to help determine which stands are most critical for treatment.

MANAGEMENT CONSIDERATIONS

Hazard calculation considers a number of factors which can be altered through silvicultural practices. Through stocking control in young stands, thinning in specific situations, and organized regeneration harvests, age, size, and species mosaics can be created which will break up the large, homogeneous, susceptible forest types. Reducing the ratio of large diameter Douglas-fir to other size and species components by removing the larger trees from the stand will reduce stand hazard by: (1) reducing the relative abundance of susceptible Douglas-fir, (2) reducing the average age of the Douglas-fir component of the stand, and (3) lowering stand density.

Removing the smaller trees from a stand to open a stand up is another management strategy to reduce hazard.

Root disease pockets in Douglas-fir are known to support high populations of Douglas-fir beetles. These population reservoirs often expand to take advantage of breeding material created during a disturbance. Management of these root disease pockets to reduce the proportion of low-vigor Douglas-fir will decrease baseline populations of Douglas-fir beetles.

RESPONDING TO DISTURBANCE

Hazard rating provides managers with information on where beetle populations are likely to develop, but for populations to achieve outbreak proportions some type of disturbance which creates abundant high-quality breeding material must occur. The best way to prevent an outbreak is to recognize when a disturbance has occurred and respond with timely treatment such as salvage of down, damaged, or severely weakened Douglas-fir. Such activity must be accomplished either before beetles attack it initially, or before they emerge the following spring.

Beetle-infested material must be treated prior to beetle flight to prevent spread of the infestation. An additional benefit of removing beetle-killed trees is the reduction in fuel loadings and subsequent fire hazard.

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